Project Title

Scale-Up and Demonstration of Fly Ash Ozonation Technology

Fourth Quarterly Technical Report
Reporting Period: January - March 2005

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DISCLAIMER

This technical report was prepared with the support of the U.S. Department of Energy, under Award No. DE-FC26-03NT41730. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the DOE.

ABSTRACT

This is the fourth quarterly report under DOE Cooperative Agreement No.: DE-FC26-03NT41730. Due a number of circumstances, mostly associated with subcontractor agreements, the actual beginning of the project was delayed from its original award date of March 5, 2003. DOE's Project Manager was kept informed (verbally) by PPL's Project Manager throughout this period.

Because of this delay, this is the fourth quarterly report and it refers to the time period from January to March 2004. The on-site deployment and testing of the ozonation system took place during this period. This report summarizes these activities including some preliminary results.

No significant issues or concerns are identified.

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INTRODUCTION

Objectives

PPL has lost concrete marketability for much of its ash from the Montour power station due to high carbon content. The objective of the project is to demonstrate ash ozonation technology on a utility site, with minimum modification to existing plant equipment and operations and to confirm the process effectiveness through a complete battery of technology performance and concrete quality tests, to develop a plan for effective implementation at the PPL Montour station and for technology transfer to other U.S. coal-fired plants.

EXECUTIVE SUMMARY

Scope of Work

Based on the results of pilot testing performed during the Spring/Summer of 2002 at the Fuller Bulk Handling (FBH) test facility, the project team determined that air merge blending is the technology of choice for fluidization/ozonation of fly ash. In Task 1 of the project, the technology will be deployed and tested at PPL's Montour Steam Electric Station, where it will be integrated with existing ash handling systems. In Task 2 technical and economic analyses will be conducted for a full-scale, commercial design of the technology. Task 3 is proposed as a "documentation" task and will produce a Final Report to DOE. These tasks are described below in more detail.

In this project, PPL will supply a continuous stream of the high-carbon problem ash, as well as ash handling equipment at the station (e.g. silos, fans, etc.). . Ash from other (non-Montour) sources will also be obtained and tested to evaluate the influence of different ash parameters on the effectiveness of the ozonation technology. PCI will supply a new SMA50 ozone generator capable of treating large quantities of ash.. A matrix of contacting conditions and carbon/ozone stoichiometries will be tested and the results compared. Concrete testing of treated ash samples will be performed by CPM and supporting analyses of the ash will be carried out at the Brown University research laboratories. A plan will be developed for implementation of the optimal process at Montour and for technology transfer to other U.S. generating plants. Finally, design guidelines will be developed to allow for an effective "jump" into commercial development.

EXPERIMENTAL

Tasks Description

The proposed scope of work will be broken down into the following major tasks:

TASK 1 – Design/Deploy/Test semi-commercial fluid bed system at Montour Station

Objective – Conduct semi-commercial scale test of fluidization/ozonation of fly ash at PPL's Montour Station using FBH's Airmerge™ blender and PCI's ozonation technologies. Building upon previous tests and development by the project team, FBH will design and fabricate a 42" diameter Airmerge™ batch blender for gas/solids contacting. PCI-Wedeco will supply a new SMA50 ozone generator capable of producing 100 lb/day of ozone operating on air. The system will be integrated with existing ash handling systems at Fly Ash Storage Silo #1 at PPL's Montour Station, as illustrated in Figure 1. Off-gases will be pre-filtered and sent to an ozone destruct unit prior to discharge to atmosphere. FBH will complete the installation approximately 5 months from the start of the project.

Six fly ashes of varying characteristics will be tested in the system to develop a range of system operating parameters. The installed system will accept ash from the silo, "ozonate" the ash in batches, and loadout the ash to PD rail cars through an existing airslide. This streamlined material flow will allow for ash throughput of about 10 tons/day. Testing is anticipated to last approximately five weeks.

The following activities, or subtasks, will be conducted in this task.

- Design and fabricate 42-inch Airmerge™ blender and SMA50 ozone generator.
- Prepare test matrix.

- Deploy fluidization/ozone generator system.
- Interface with Montour ash handling systems (storage silos, dry ash loadout, etc.)
- Conduct parametric tests
    - Operating parameters
        - *fluidization/aeration velocities*
        - *vibratory fluidization enhancement*
        - *raw ash quality (different sources and carbon content)*
        - *ozone reaction stoichiometry (gm-ozone/kg-ash)*
- Conduct ash and concrete analyses (foam index, mortar air-entraining tests, petrography, trial batches for short and extended mixing times)
- Results documentation
- Reporting to DOE

TASK 2 – Design Full Scale-up for Montour Station and Development of Generic Design Guidelines

Objective – Develop design modifications for the full scale-up of the ash fluidization/ozonation system based on overall performance considerations from Task 1. This will serve to demonstrate low-cost retrofit potential to existing systems at normal operating conditions. Develop generic design guidelines addressing technical and cost considerations, for commercializing the technology. The following activities, or subtasks, will be conducted in this task.

- Design modifications for existing systems
- Develop design guidelines for wide-applicability ozonation systems
- Cost/Economic analyses
- Results documentation
- Reporting to DOE

TASK 3 – Final Report

Objective – Provide full documentation of project results and develop design guidelines, cost estimates commercialization potential for the technology. This will include:

- Design criteria
- Performance expectations
- Cost
- Applicability
- Deployment and operation

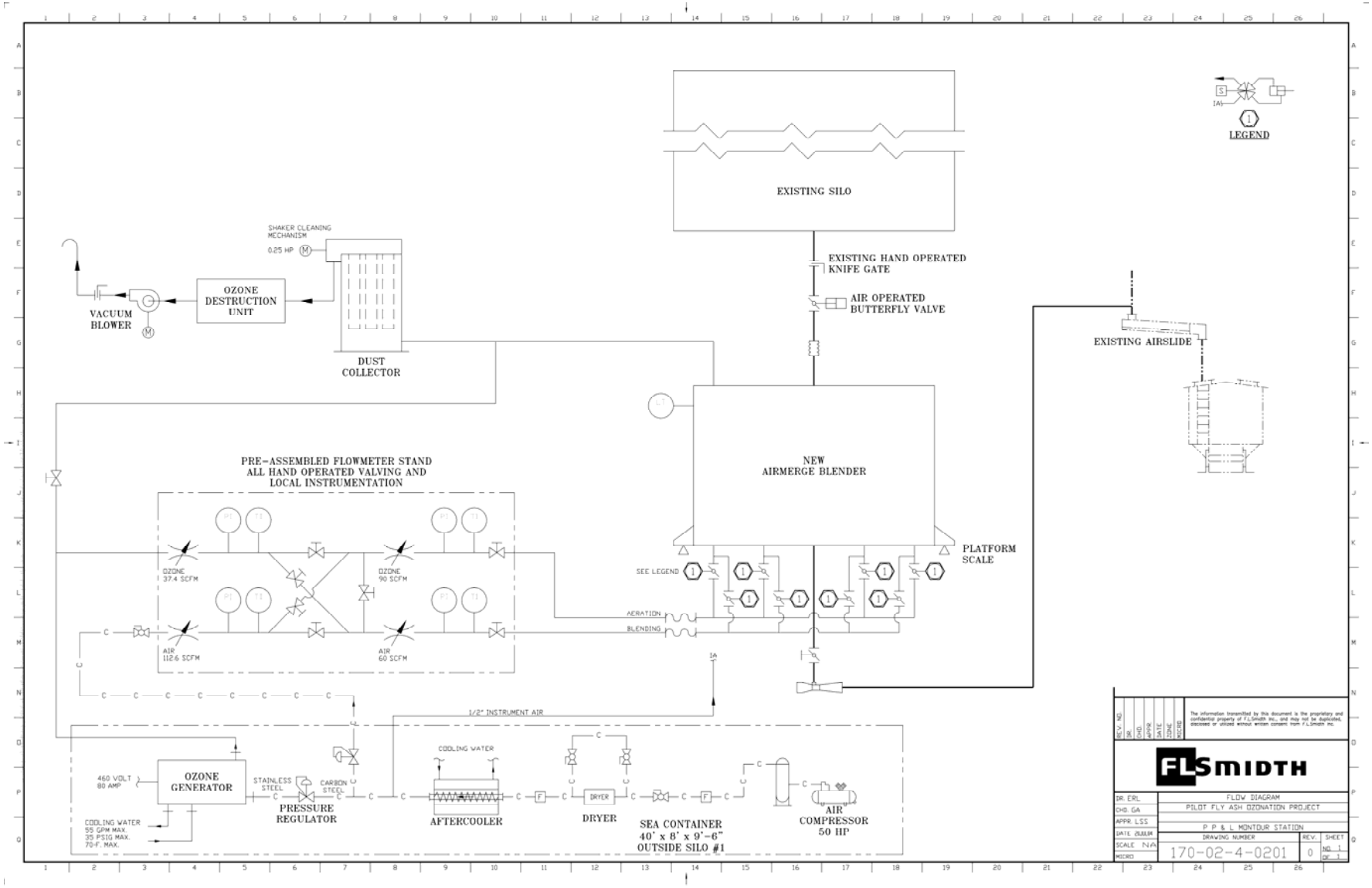


Figure 1 - Task 1 Semi-commercial scale installation of fluidization/ozonation technology at Montour (revised)

RESULTS AND DISCUSSION

The project has progressed on schedule and without any significant issues of concern throughout this quarterly period (January - March). The major activities during this period included the deployment of the ash ozonation system at the Montour plant, as well as the testing of the several ashes as planned. The installation of the ozonation system occurred in January – February with initial "shake-down" in early February. Aside from minor typical installation challenges, this task was completed timely and successfully.

The on-site test program was started on February 22, 2005 and ended on March 21, 2005. Analyses of all the parametric test results are currently underway. Dedicated concrete testing of selected treated ashes are also ongoing at present.

The flow chart below (figure 2) provided a general approach for the first batch of tests intended to determine the impacts of the major operating parameters (fluidization, ozone levels, contact times, bed height, velocities). This served as a guideline to "move through" the initial parametric tests and ensure that we are thorough as well as efficient. It essentially shows the logic behind the first phase of testing. Based on the "lessons learned" from the first batch of parametric tests, the actual test program is summarized in figure 3. It identifies the ash source, type of fluidization approach (Airmerge mode vs. conventional fluid bed mode), as well as other relevant parameters (O3 concentration, mixing flow "intensity" (max vs. min fluidization)

Figure 2. Initial Test Matrix Logic Flow Chart

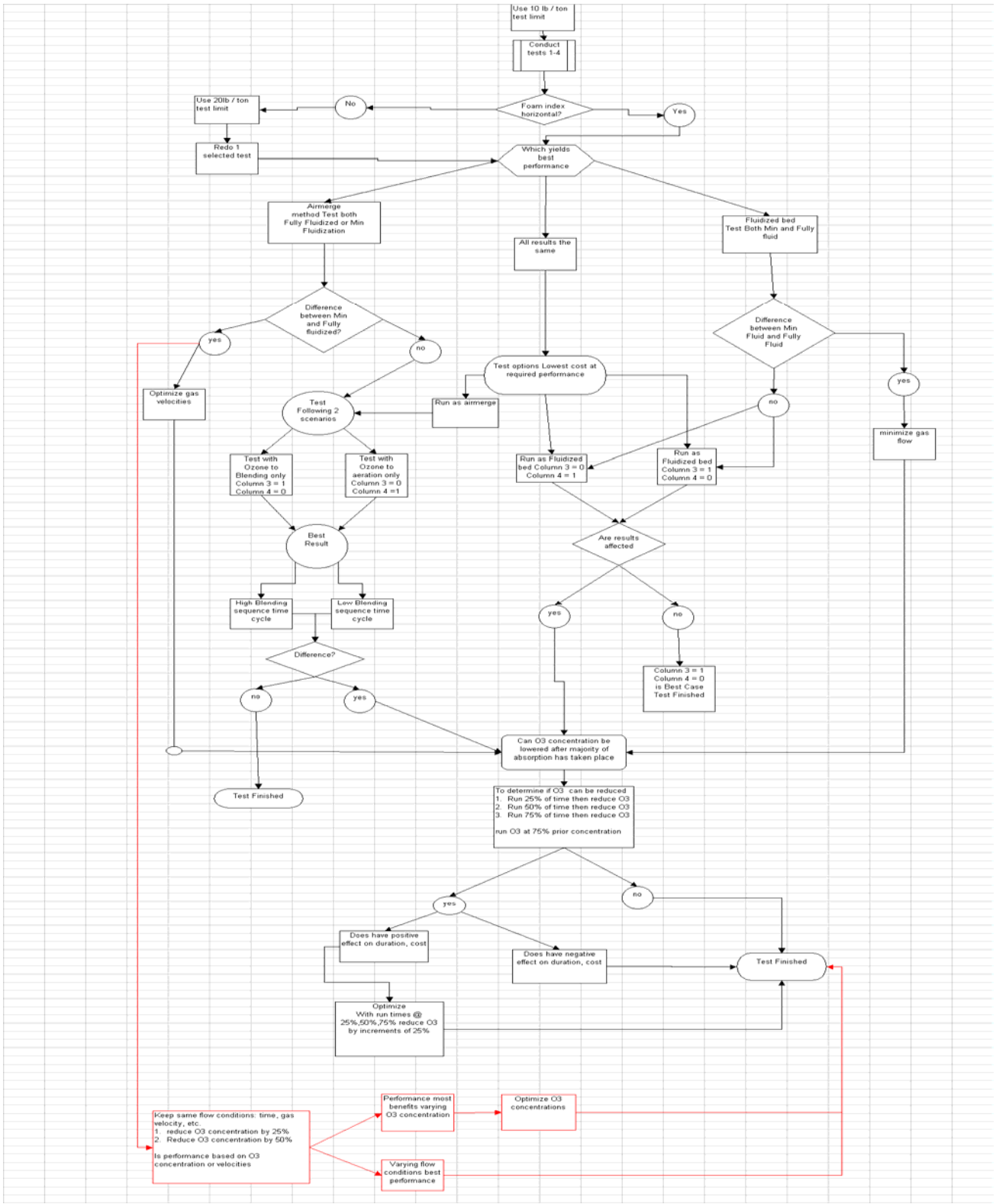


Figure 3. Final Test Program

Test #	Sample	Test Description	O3 Concentration	O3 Flow	Total Flow
			%	SCFM	SCFM
1	PPL Hard Grind Ash	Max Airmerge	2	20	20
2	PPL Hard Grind Ash	Min Airmerge	2	13	13
3	PPL Hard Grind Ash	Max Fluidized	2	20	20
4	PPL Hard Grind Ash	Min Fluidized	2	8	8
5	PPL Hard Grind Ash	Max Fluidized	1	20	20
6	PPL Hard Grind Ash	Max Airmerge	2	8	20
7	PPL Hard Grind Ash	Max Fluidized	0.5	20	20
8	PPL Hard Grind Ash	Max Fluidized	2	20	20
9	PPL Reg Grind Ash	Max Fluidized	2	12	35
10	PPL Reg Grind Ash	Min Fluidized	2	18	18
11	PPL Reg Grind Ash	Max Airmerge	2	12	35
12	Dairyland, Class C	Max Airmerge	2	18	70
13	PPL Reg Grind Ash	Max Fluidized	2	18	35
14	Dairyland Genova	Max Fluidized	2	16	26
15	Dairyland Genova	Max Airmerge	2	16	26
16	Dairyland Genova	Min Fluidized	2	16	20
17	5% AC & STI Ash	Max Fluidized	2	12	12
18	1.5% AC & STI Ash	Max Fluidized	2	12	12

Preliminary Results

Preliminary Foam Index (FI) results for all the tests at Montour have been reviewed. The current indication is that the application of ozone was quite successful for all ashes (both class F and C) at dosages of 0.5lb to 2 lb per 1000 lbs of ash. In fact, the mode of blender operations seemed to only have a secondary effect. This is a potentially good outcome, as a simple fluidization mode will result in a less complex vessel design and operating procedure then an Airmerge vessel.

Sample ash buckets were retained for concrete testing at several points during the tests and such testing is underway. Initial tests of the Montour “hard grind” ash, confirmed the FI trends observed during the ozonation tests that indicated the successful “deactivation” of the ash.

The test results for the STI ash "contaminated" with Activated Carbon are still being evaluated. However, we can say that for the 1.5% AC sample (a high but reasonable concentration of AC possibly to be found in "real" mercury control scenarios), the ozone treatment seemed highly effective. The other sample (an extremely high 5% AC concentration likely not to be found in "real" hg control scenarios) is still being analyzed.

Figures 4 and 5 show preliminary graphical results for the Montour "hard grind" ash. These are intended only as an indication of the results for purposes of this quarterly report, but the format of the data presentation for the final report may change as additional analyses are completed. The results indicate quite good "deactivation" of the ash for both high and low fluidization rates.

Figure 4. Sample test results – Montour "hard grind" with high fluidization

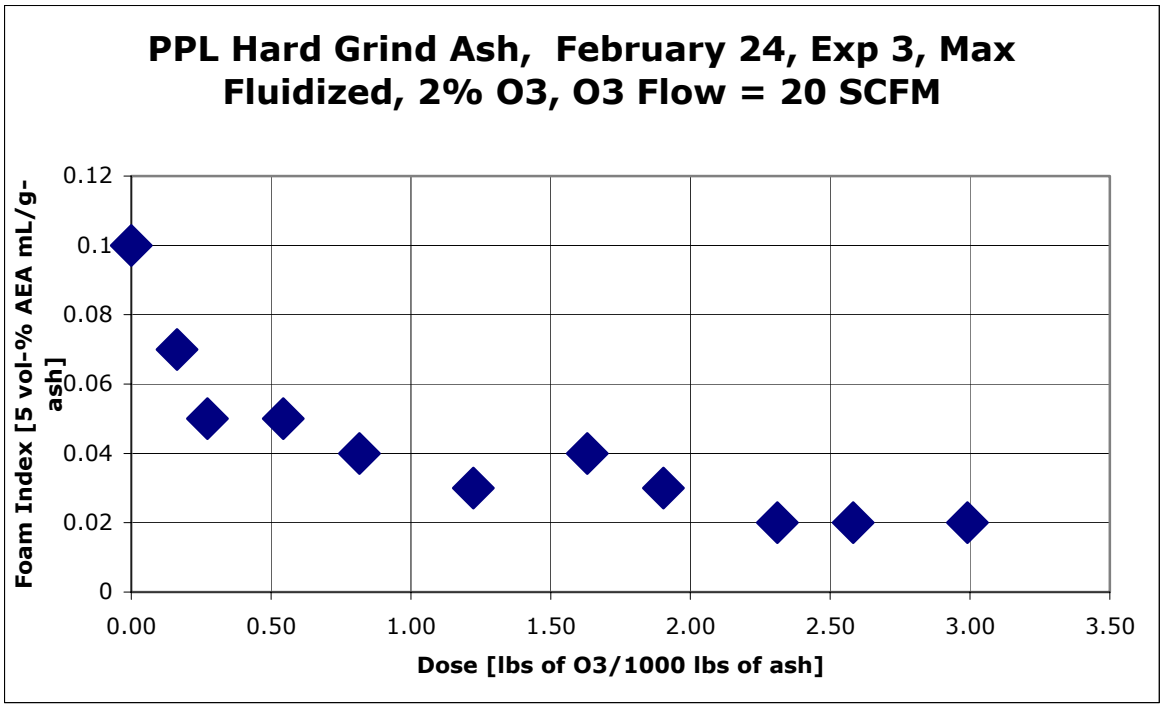
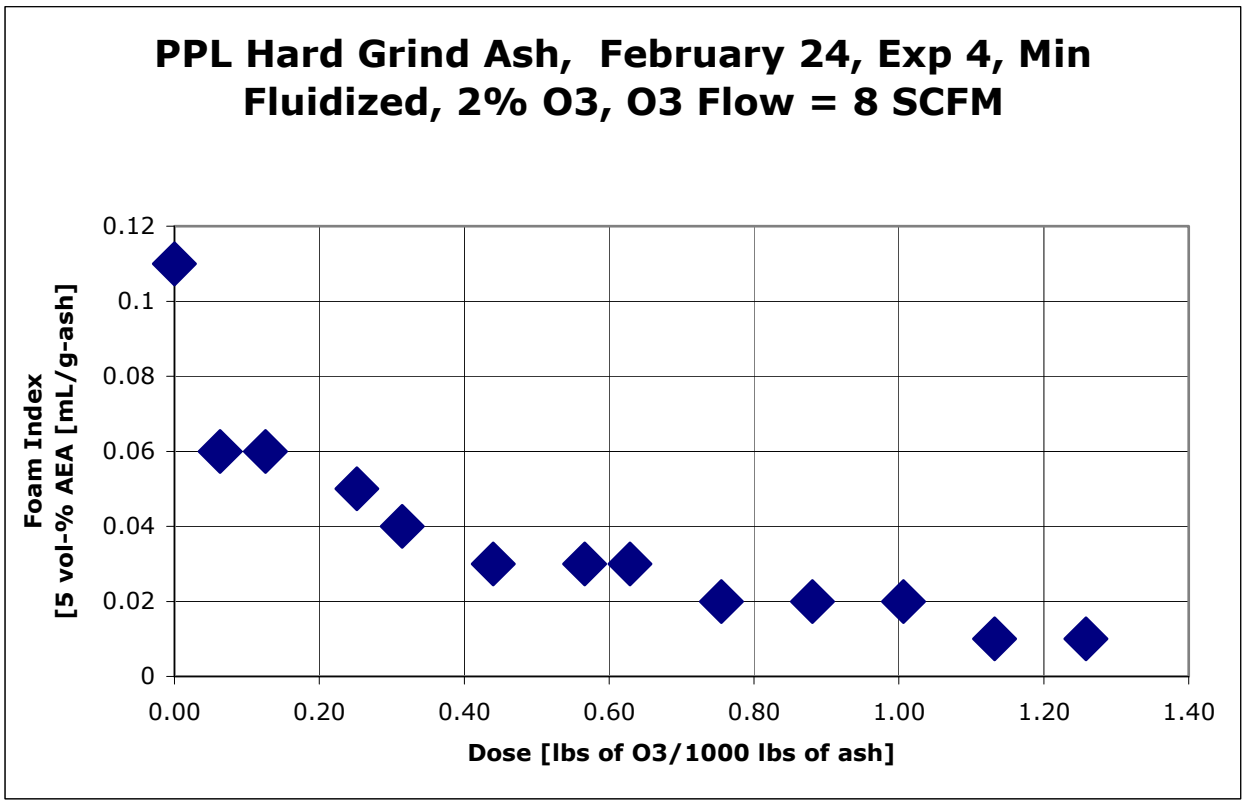


Figure 5. Sample test results – Montour "hard grind" with low fluidization



Next Reporting Period

Key tasks for the next reporting period

- Continue data analyses
- Complete and analyze concrete tests
- Start scale up engineering ands economic assessment tasks

CONCLUSIONS

No conclusions for this reporting period beyond the already stated encouraging results for the data reviewed to date.

REFERENCES

None for this reporting period.

LIST OF ACRONYMS AND ABBREVIATIONS

DOE	Department of Energy
ESP	Electrostatic precipitator
FGD	Flue gas desulfurization
ID Fan	Induced draft fan
FI	Foam Index
cfm	Cubic feet per minute
kW	Kilowatt
MW	Megawatt
NETL	National Energy Technology Laboratory
O&M	Operating and Maintenance
PC	Pulverized coal
PRB	Powder River Basin
FBH	Fuller Bulk Handling Division
PPL	PPL Generation, LLC
EPRI	Electric Power Research Institute
EES	Energy and Environmental Strategies